# ELECTRONIC DISPLACEMENT EFFECTS

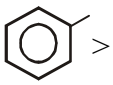
## EXERCISE # O-I

**1.** Which of the following is false order of – I effect ?

(A) –F > –Cl > –Br > –I

(B) $-\overset{\oplus}{N}R_3 > -\overset{\oplus}{N}H_3 > -NO_2$

(C) –F > –OH > $-NH_2$

(D)  > –C ≡ CH > –H

**2.** What is the correct order of inductive effect ?

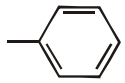
(A) $-O^- > -CH_3 > -CMe_3$

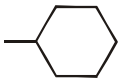
(B) $-CO_2^- > -O^- > CHMe_2$

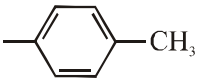
(C) $-O^- > -CH_2Me$ > –D > –H

(D) None

**3.** Which of the following groups have + I effect :

(A) 

(B) 

(C) 

(D) —CH = $CH_2$

**4.** Which of the following groups have –I effect :

(A) —OH

(B) —C(=O)—OH

(C) $-CH_3$

(D) $-OCH_3$

**5.** How many of the following groups have + I effect :

(a) —OH (b) $-O^{\ominus}$ (c) $-NH_2$ (d) $-\overset{\ominus}{N}H$

(e) —COOH (f) $-COO^{\ominus}$ (g) —Me (h) —OMe

(i) —F (j) $-\overset{\oplus}{N}F_3$

**6.** Which of the following statements is (are) true about resonance.

(a) Resonance is an intramolecular phenomenon.

(b) Resonance involves delocalization of both σ and π electrons.

(c) Resonance involves delocalization of π electrons only.

(d) Resonance decreases potential energy of an acyclic molecule.

(e) Resonance has no effect on the potential energy of a molecule.

(f) Resonance is the only way to increase molecular stability.

(g) Resonance is not the only way to increase molecular stability.

(h) Any resonating molecule is always more stable than any non resonating molecule.

(i) The canonical structure explains all features of a molecule.

(j) The resonance hybrid explains all features of a molecule.

(k) Resonating structures are real and resonance hybrid is imaginary.

(l) Resonance hybrid is real and resonating structures are imaginary.

(m) Resonance hybrid is always more stable than all canonical structures.

**7.** Which of the following statement is incorrect ?

(A) Resonating structure are real & have real existence

(B) Equivalent contributing structures make resonance hybrid very stable.

(C) Contributing structures are hypothetical having no real existance

(D) Contributing structures are less stable than the resonance hybrid.

**8.** Which of the following is most stable.

(A) Conjugated alkadiene ($CH_2 = CH—CH = CH_2$)

(B) Isolated alkadiene ($CH_2 = CH—CH_2—CH = CH_2$)

(C) Cumulated alkadiene ($CH_2 = C = CH_2$)

(D) All are equally stable

**9.** Arrange the following resonating structure according to their contribution towards resonance hybrid?

(a) $CH_2 = \overset{\oplus}{N} = \overset{\ominus}{N}$ (b) $\overset{\ominus}{C}H_2–N=\overset{\oplus}{N}$ (c) $\overset{\oplus}{C}H_2–\underset{\cdot\cdot}{N}=\overset{\ominus}{N}$ (d) $\overset{\ominus}{C}H_2–\overset{\oplus}{N}\equiv\ddot{N}$

(A) a > d > c > b (B) b > a > c > d (C) a > c > b > d (D) d > a > b > c

**10.** A canonical structure will be more stable if

(A) it involves cyclic delocalization of $(4n + 2)\ \pi$ – electrons than if it involves acyclic delocalization of $(4n + 2)\ \pi$ – electrons.

(B) it involves cyclic delocalization $(4n)\ \pi$ – electrons than if it involves acyclic delocalization of $(4n)\ \pi$ – electrons.

(C) +ve charge is on more electronegative atom than if +ve charge is on less electronegative atom provided atoms are in the same period.

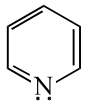
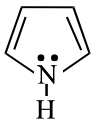
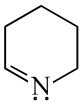
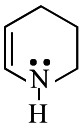
(D) –ve charge is on more electronegative atom than if –ve charge is on less electronegative atom provided atoms are in the same period.

**11.** Which one of the following pair of structures does not represent the phenomenon of resonance?

(A) $H_2C=CH-\overset{\overset{O}{\|}}{C}-H$ ; $\overset{+}{C}H_2-CH=\overset{\overset{O^-}{|}}{C}-H$ (B) $CH_2=CH-\overset{+}{C}HCl$ ; $\overset{+}{C}H_2-CH=CH-Cl$

(C) $(CH_3)_2CH-\overset{\overset{O}{\|}}{C}-O^-$ ; $(CH_3)_2CH-\overset{\overset{O^-}{|}}{C}=O$ (D) $CH_3-CH_2-\overset{\overset{O}{\|}}{C}-CH_3$ ; $CH_3-CH=\overset{\overset{O^-}{|}}{C}-CH_3$

**12.** In which of the following, lone-pair indicated is involved in resonance :

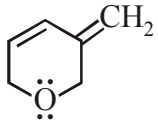
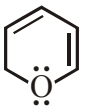
(a)  (b)  (c)  (d) 

(e) $CH_2 = CH - \overset{\ominus}{C}H_2$ (f) $CH_2 = CH - CH = \ddot{N}H$

**13.** In which of the following lone-pair indicated is not involved in resonance :

(a) $CH_2 = CH - \ddot{N}H - CH_3$ (b) $CH_2 = CH - CH = \ddot{O}$

(c) $CH_2 = CH - \ddot{O} - CH = CH_2$ (d) $CH_2 = CH - C \equiv N:$

(e)  (f) 

**14.** Which of the following groups cannot participate in resonance with other suitable group :

(a) – COOH (b) $-COOCH_3$ (c) – COCl (d) $-\overset{\oplus}{N}H_3$

(e) $-\overset{\oplus}{C}H_2$

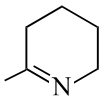
**15.** Identify electron donating groups in resonance among the following :

(a) $-CONH_2$ (b) $-NO_2$ (c) $-OCOCH_3$ (d) $-COOCH_3$

(e) – CHO (f) $-NHCOCH_3$

**16.** Identify electron withdrawing groups in resonance among the following :

(a) –COOH (b) $-CONHCH_3$ (c) – COCl (d) – CN

(e) $-O-CH=CH_2$ (f) 

**17.** Which of the following groups can either donate or withdraw a pair of electrons in resonance depending upon situation :

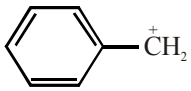
(a) $-NO_2$ (b) – NO (c) $-CH=CH_2$ (d) – CHO

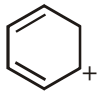
(e) $-NH_2$ (f) – N = NH

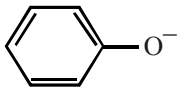
**18.** Draw the resonance forms to show the delocalization of charges in the following ions

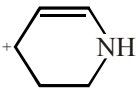
(a) $CH_3-\overset{\displaystyle O}{\overset{\|}{C}}-\overset{\ominus}{C}H_2$

(b) $H-\overset{\displaystyle O}{\overset{\|}{C}}-CH=CH-\overset{\ominus}{C}H_2$

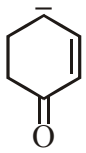
(c) 

(d) 

(e) 

(f) 

(g)

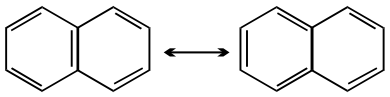
(h) 

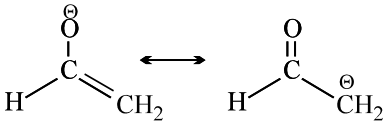
(i) $CH_3 - CH = CH - CH = CH - \overset{+}{C}H - CH_3$

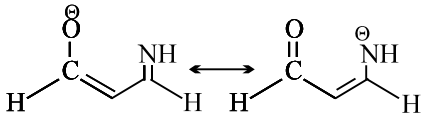
(j) $CH_3 - CH = CH - CH = CH - \overset{+}{C}H_2$

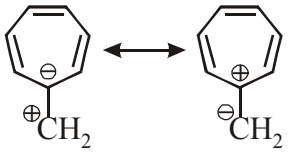
**19.** Identify less stable canonical structure in each of the following pairs :

(a) $\overset{\oplus}{C}H_2 - O - CH_3 \longleftrightarrow CH_2 = \overset{\oplus}{O} - CH_3$

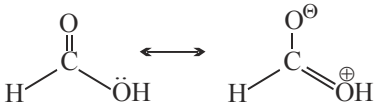
(b) 

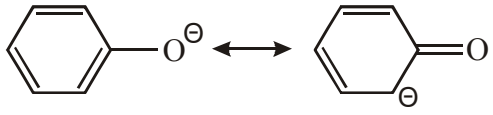
(c) 

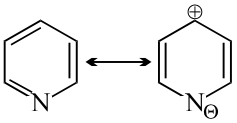
(d) 

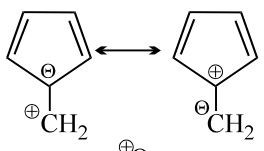
(e) 

**20.** Identify more stable canonical structure in each of the following pairs :

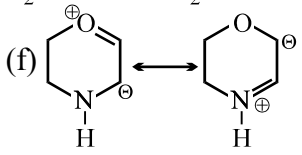
(a) 

(b) 

(c) 

(d) 

(e) $\overset{\oplus}{C}H_2 - CH = CH - \overset{\Theta}{O} \longleftrightarrow CH_2 = CH - CH = O$

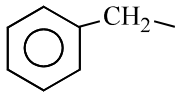
(f) 

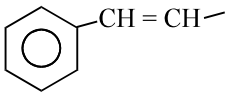
Which of the following group can participate in resonance with other suitable group :

(a) –OH

(b) $-CH_2-\overline{C}H_2$

(c) $-CH_2-\overset{\oplus}{C}H_2$

(d) 

(e) 

(f) $-BH_2$

(g) $-\overset{\oplus}{P}Ph_3$

**22.** Consider structural formulas A, B and C:

$H_2\ddot{C}—N\equiv N:$ (A) $\quad H_2C=N=\ddot{N}:$ (B) $\quad H_2C—\ddot{N}=\ddot{N}:$ (C)

(a) Are A, B and C isomers, or are they resonance forms ?

(b) Which structures have a negatively charged carbon?

(c) Which structures have a positively charged carbon?

(d) Which structures have a positively charged nitrogen?

(e) Which structures have a negatively charged nitrogen?

(f) What is the net charge on each structure?

(g) Which is a more stable structure, A or B? Why?

(h) Which is a more stable structure, B or C? Why?

**23.** In each of the following pairs of resonating structure which resonating structure is more stable :

(a) $\left[\ddot{\overline{C}}H-C\equiv N: \longleftrightarrow CH_2=CH=\ddot{N}:^{-}\right]$

(b) $\left[CH_3-\overset{O}{\overset{\|}{C}}-\overline{C}H-\overset{O}{\overset{\|}{C}}-CH_3 \longleftrightarrow CH_3-\overset{O^-}{\overset{|}{C}}=CH-\overset{O}{\overset{\|}{C}}-CH_3\right]$

(c) $\left[CH_3-CH_2-\overset{NH_2}{\overset{|}{\underset{+}{C}}}-NH_2 \longleftrightarrow CH_3-CH_2-\overset{NH_2}{\overset{|}{C}}=\overset{+}{N}H_2\right]$

**24.** Formic acid is considered as a hybrid of the four structures

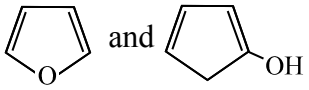
$$H-\overset{O}{\overset{\|}{C}}-OH \leftrightarrow H-\overset{O^{\ominus}}{\overset{|}{C}}=\overset{\oplus}{O}H \leftrightarrow H-\overset{O^{\ominus}}{\overset{|}{\underset{\oplus}{C}}}-O-H \leftrightarrow H-\overset{O^{\oplus}}{\overset{|}{\underset{\ominus}{C}}}-O-H$$

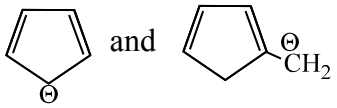
I II III IV

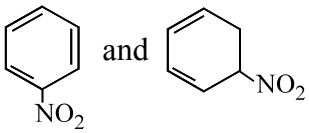
Which of the following order is correct for the stability of four contributing structures.

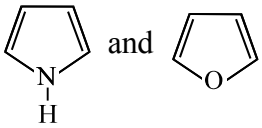
(A) I > II > III > IV (B) I > II > IV > III (C) I > III > II > IV (D) I > IV > III > II

**25.** In the given pair of compounds select the one in each pair having lesser resonance energy :

(a)  and

(b)  and

(c)  and

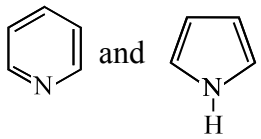
(d)  and

**26.** Resonance energy of resonance hybrid of a molecule will be more if :

(a) canonical structures are equivalent than if canonical structures are non-equivalent

(b) molecule is aromatic than if molecule is not aromatic.

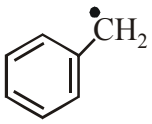
**27.** In the given pair of compounds select the one in each pair having higher resonance energy :

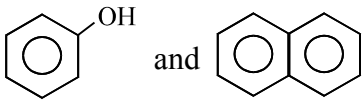
(i)  and

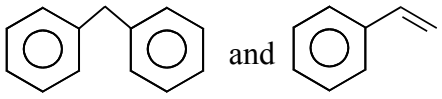
(ii) $CH_2 = CH - O - CH = CH_2$ and $CH_2 = CH - NH - CH = CH_2$

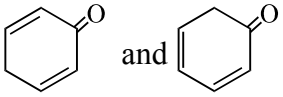
(iii) $CH_2 = CH - \overset{\Theta}{N}H$ and $HN = CH - \overset{\Theta}{N}H$

(iv) $CH_2 = CH - F$ and $CH_2 = CH - Br$

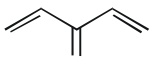
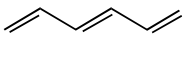
(v)  and $CH_2 = CH - \dot{C}H_2$

(vi)  and

(vii)  and

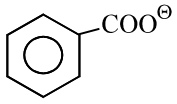
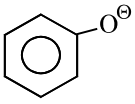
(viii)  and

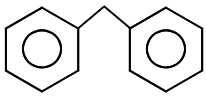
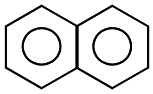
(ix) $CH_2 = CH - OH$ and $CH_2 = CH - CH = CH - OH$

(x)  and 

(xi) $CH_3COOH$ and $CH_3COONa$

(xii) $CH_2 = CH - \overset{\Theta}{O}$ and $CH_2 = CH - OH$

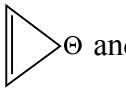
(xiii)  and 

(xiv)  and 

(xv) and $CH_2 = CH - CH = CH - CH = CH_2$

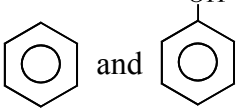
**28.** In the given pair of compounds select the one in each pair having lesser resonance energy :

(a) $CO_3^{2-}$ and $HCOO^-$

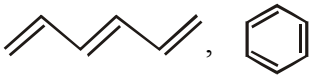
(b)  and $CH_2 = CH - CH_2^-$

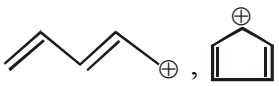
(c) and $CH_2 = CH - CH = CH_2$

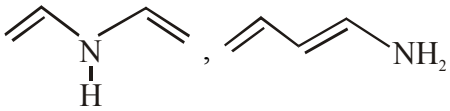
(d) and $CH_2 = CH - \overset{\oplus}{C}H_2$

(e) 

**29.** In which of the following pairs first one is having more resonance energy than the second one -

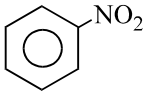
(A) 

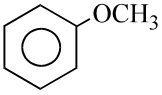
(B) 

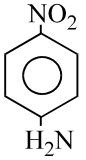
(C) 

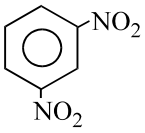
(D) None of these

**30.** In which of the following molecules $\pi$ – electron density in ring is minimum :

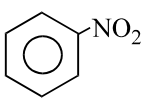
(A) 

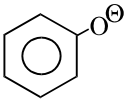
(B) 

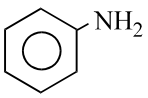
(C) 

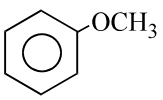
(D) 

**31.** In which of the following molecules $\pi$ – electron density in ring is maximum :

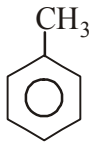
(A) 

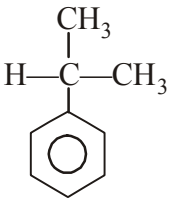
(B) 

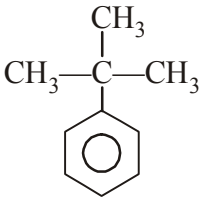
(C) 

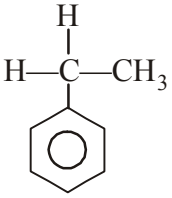
(D) 

**32.** Arrange following compounds in decreasing order of reactivity of ring towards attack of electron deficient species -

(i) 

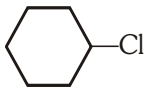
(ii) 

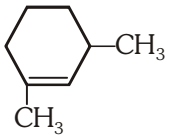
(iii) 

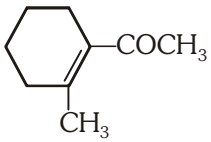
(iv) 

(A) i > ii > iii > iv (B) iii > iv > ii > i (C) i > iv > ii > iii (D) i > ii > iv > iii

**33.** In which of the following molecule all the effect namely inductive, mesomeric & hyperconjugation operate:

(A) 

(B) 

(C) 

(D)

**34.** Which one of the following molecules has all the effect, namely inductive, mesomeric and hyperconjugative?

(A) $CH_3Cl$ (B) $CH_3–CH = CH_2$

(C) $CH_3 - CH = CH - \underset{\underset{O}{\|}}{C} - CH_3$ (D) $CH_2 = CH - CH = CH_2$

**35.** Select the correct statement.

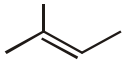
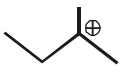
(i) Delocalisation of σ-electron is hyperconjugation.

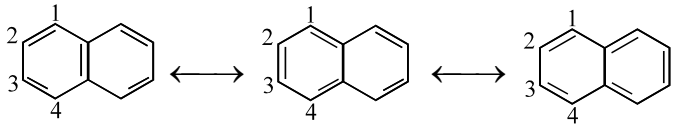
(ii) Delocalisation of π-electron is resonance.

(iii) Permanent partial displacement of σ-electron is inductive effect.

(A) i & iii (B) ii & iii (C) i & ii (D) i, ii, iii

**36.** Which of the following compound is correctly matched with number of hyperconjugating structures (involving C—H bond) :

(A) (3) (B)  (9) (C)  (8) (D) $CH_3–C\equiv C–CH$ (5)

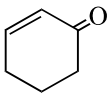
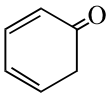
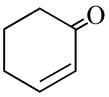
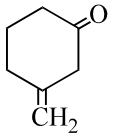
**37.** 

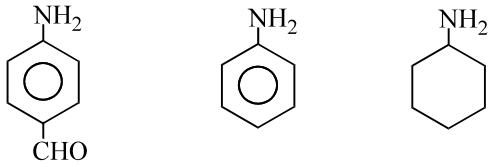
These are three canonical structures of naphthalene. Examine them and find correct statement among the following :

(A) All C – C bonds are of same length (B) C1 – C2 bond is shorter than C2 – C3 bond.

(C) C1 – C2 bond is longer than C2 – C3 bond (D) None

**38.** Which of the following has longest C – O bond :

(A)  (B)  (C)  (D) 

**39.** 

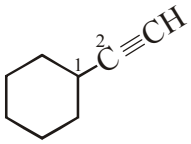
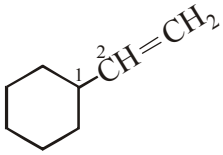
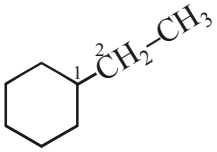
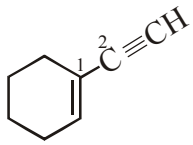
I II III IV

$CH_2 = NH$

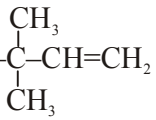
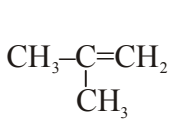
Among these compounds, the correct order of C – N bond lengths is :

(A) IV > I > II > III (B) III > I > II > IV (C) III > II > I > IV (D) III > I > IV > II

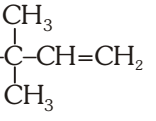
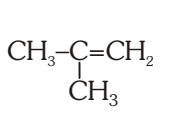
**40.** C1 – C2 bond is shortest in

(A)  (B)  (C)  (D) 

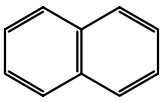
**41.** Which of the following molecule has longest C=C bond length ?

(A) $CH_2=C=CH_2$ (B) $CH_3–CH=CH_2$ (C)  (D) 

**42.** Which of the following molecule has shortest C=C bond length ?

(A) $CH_2=C=CH_2$ (B) $CH_3–CH=CH_2$ (C)  (D) 

**43.** C—C and C=C bond lengths are unequal in :

(A) Benzene (B) 1,3-buta-di-ene (C) 1,3-cyclohexa-di-ene (D) 

**44.** Among the following molecules, the correct order of C – C bond length is ($C_6H_6$ is benzene)

(A) $C_2H_6 > C_2H_4 > C_6H_6 > C_2H_2$ (B) $C_2H_6 > C_6H_6 > C_2H_4 > C_2H_2$

(C) $C_2H_4 > C_2H_6 > C_2H_2 > C_6H_6$ (D) $C_2H_6 > C_2H_4 > C_2H_2 > C_6H_6$

**45.** $CH_3O - CH = CH - NO_2$ I

$CH_2 = CH - NO_2$ II

$CH_2 = CH - Cl$ III

$CH_2 = CH_2$ IV

Which of the following is the correct order of C – C bond lengths among these compounds :

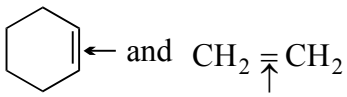
(A) I > II > III > IV (B) IV > III > II > I (C) I > III > II > IV (D) II > III > I > IV

**46.** Which of the following is (are) the correct order of bond lengths :

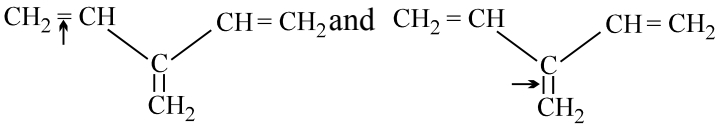
(A) C – C > C = C > C ≡ C > C ≡ N (B) C = N > C = O > C = C

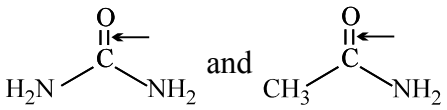
(C) C = C > C = N > C = O (D) C – C > C = C > C ≡ C > C – H

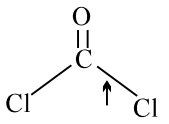
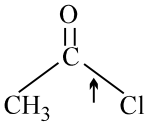
**47.** In which of the following pairs, indicated bond having less bond dissociation energy :

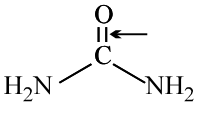
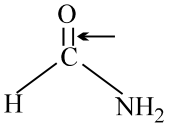
(a) 

(b) $CH_3 - C \equiv CH$ and $HC \equiv CH$

(c) 

(d) 

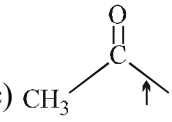
(e)  and 

(f)  and 

**48.** In which of the following pairs, indicated bond is of greater strength :

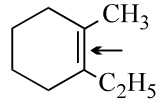
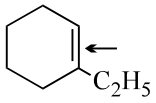
(a) $CH_3-CH_2-Br$ and $CH_3-CH_2-Cl$

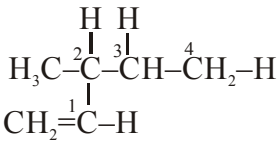
(b) $CH_3-CH=CH-Br$ and $CH_3-\underset{\underset{Br}{|}}{CH}-CH_3$

(c)  and $CH_3-CH_2-Cl$

(d) $CH_2=CH-CH=CH_2$ and $CH_2=CH_2-CH_2-CH_3$

(e) $CH_2=CH-CH=CH_2$ and $CH_2=CH-NO_2$

(f)  and 

**49.** 

the correct order of bond dissociation energy (provided bond undergoes homolytic cleavage):

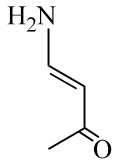
(A) $C^2$–H > $C^3$– H > $C^4$ –H > $C^1$ – H

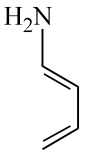
(B) $C^2$–H > $C^3$– H > $C^1$ –H > $C^4$ – H

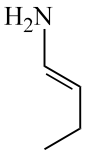
(C) $C^1$–H > $C^4$– H > $C^2$ –H > $C^3$ – H

(D) $C^1$–H > $C^4$– H > $C^3$ –H > $C^2$ – H

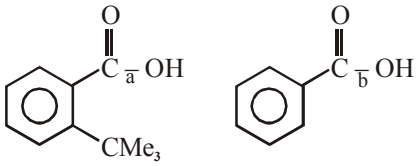
**50.** Compare the C–N bond-length in the following species:

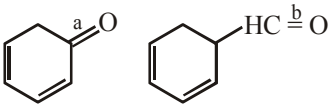
(A) 

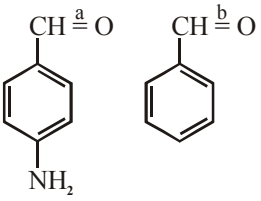
(B) 

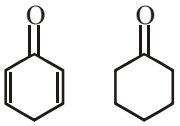
(C) 

**51.** In which case, C – O bond length is shorter for I$^{st}$ compound :

(A) 

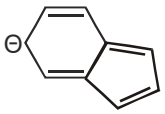
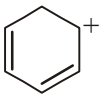
(B) 

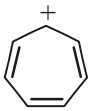
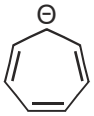
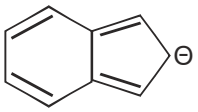
(C) 

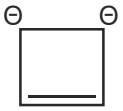
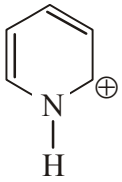
(D) 

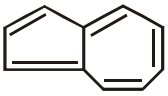
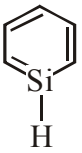
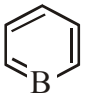
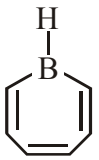
## EXERCISE # O-II

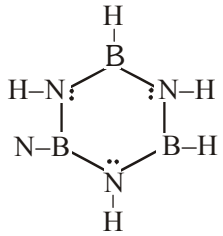
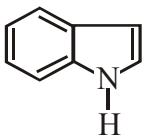
**1.** In each set of species select the aromatic species.

(i) (a)  (b) (c) 

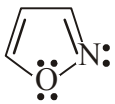
(ii) (a)  (b)  (c)  (d)

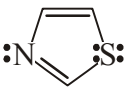
(iii) (a) (b)  (c) (d) 

(iv) (a)  (b)  (c)  (d) 

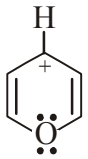
(e)  (f) 

**2.** Which of the given compound is aromatic, antiaromatic or nonaromatic.

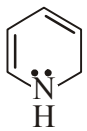
(a) 
isoxazole

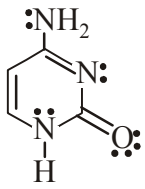
(b) 
1,3-thiazole

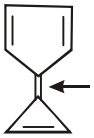
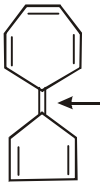
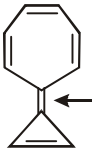
(c)
pyran

(d) 
pyrylium ion

(e)
γ-pyrone

(f) 
1,2-dihydropyridine

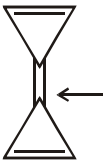
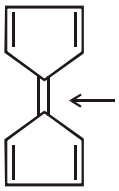
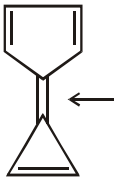
(g) 
cytosine

**3.** (I)  (II)  (III) 

Compare carbon-carbon bond rotation across I, II, III.

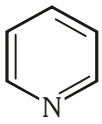
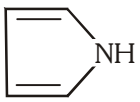
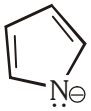
(A) I > II > III (B) I > III > II (C) II > I > III (D) II > III > I

**4.** Which of the given compunds has minimum rotation energy barrier across indicated carbon-carbon bond.

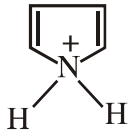
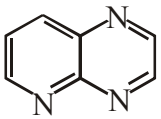
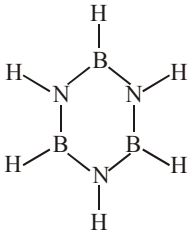
(I)  (II)  (III) 

(A) I (B) II (C) III (D) All are equal

**5.** Which species is not aromatic ?

(A)  (B) (C)  (D) 

**6.** Which of the following are non-aromatic

(A)  (B) (C)  (D) 

**7.** Write down the structure of the following molecule and comment on aromaticity ?

(a) $B_3H_3O_3$ (b) $C_3N_3(NH_2)_3$ (c) Trimer of isocyanic acid $(HN = C = O)_3$

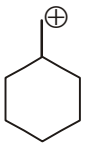
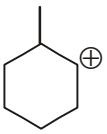
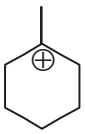
**8.** Select the least stable one :

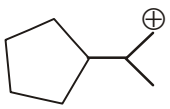
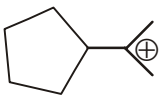
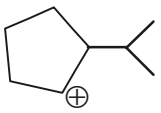
(A) $CH_3-\overset{\oplus}{C}H_2$ (B) $CH_3-CH_2-\overset{\oplus}{C}H_2$

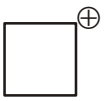
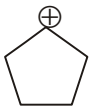
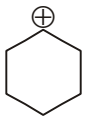
(C) $\begin{matrix}H_3C\\H_3C\end{matrix}\!\!>\!CH-\overset{\oplus}{C}H_2$ (D) $\begin{matrix}H_3C\\H_3C\\H_3C\end{matrix}\!\!>\!C=\overset{\oplus}{C}H_2$

**9.** Write stability in decreasing order of following intermediates:

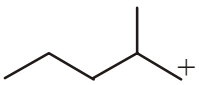
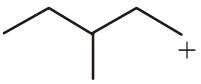
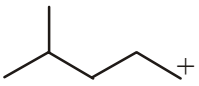
(i) (a) $CH_3-\overset{\oplus}{C}H_2$ (b) $CH_3-\overset{\oplus}{C}H-CH_3$ (c) $CH_3-\overset{CH_3}{\overset{|}{\underset{CH_3}{\underset{|}{C}}}}\oplus$

(ii) (a)  (b)  (c) 

(iii) (a)  (b)  (c) 

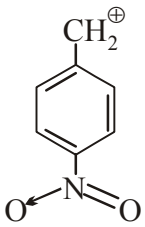
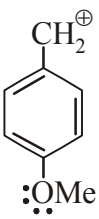
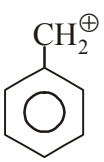
(iv) (a) (b)  (c)  (d) 

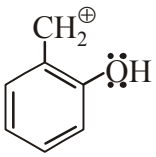
(v) (a) $CF_3-\overset{+}{C}H_2$ (b) $CCl_3-\overset{+}{C}H_2$ (c) $CBr_3-\overset{+}{C}H_2$

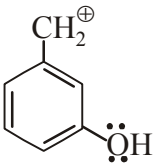
(vi) (a)  (b)  (c) 

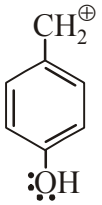
(vii)(a) $HC\equiv\overset{\oplus}{C}$ (b) $CH_2=\overset{\oplus}{C}H$ (c) $CH_3-\overset{\oplus}{C}H_2$

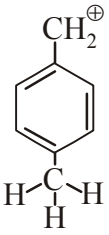
(viii) (a) $C_6H_5^+$ (b) p–$NO_2(C_6H_4)^+$ (c) p–$CH_3$–$(C_6H_4)^+$ (d) p–Cl–$C_6H_4^+$

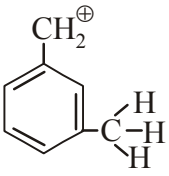
(ix) (a)  (b)  (c) 

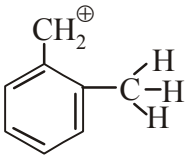
(x) (a) 

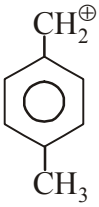

(b) 

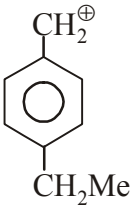

(c) 

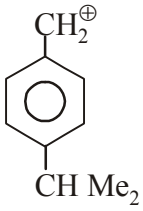

(xi) (a) 

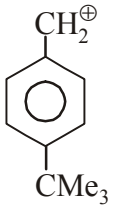

(b) 

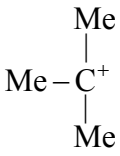

(c) 

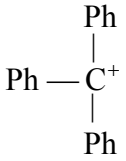

(xii) (a) 

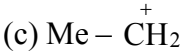

(b) 

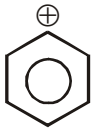

(c) 

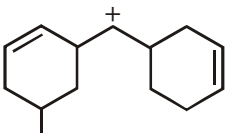

(d) 

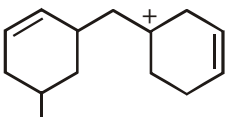

(xiii) (a) 

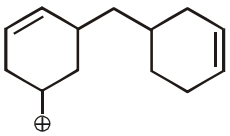

(b) 

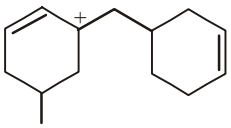

(c) 

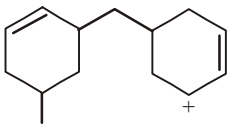

(d) 


(xiv)(a) 

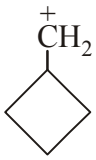

(b) 

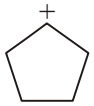

(c) 


(d) 

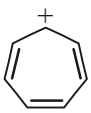

(e) 


(xv) (a)


(b) 


(c) 


(xvi) (a)


(b) 


(c)

**10.** Consider the following statements:

(I) $CH_3O\overset{\oplus}{C}H_2$ is more stable than $CH_3\overset{\oplus}{C}H_2$

(II) $Me_2\overset{\oplus}{C}H$ is more stable than $CH_3CH_2\overset{\oplus}{C}H_2$

(III) $CH_2=CH-\overset{\oplus}{C}H_2$ is more stable than $CH_3CH_2\overset{\oplus}{C}H_2$

(IV) $CH_2=\overset{\oplus}{C}H$ is more stable than $CH_3\overset{\oplus}{C}H_2$

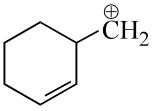
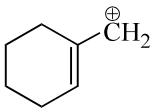
Of these statements:

(A) I and II are correct (B) III and IV are correct

(C) I, II and III are correct (D) II, III and IV are correct

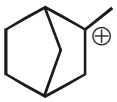
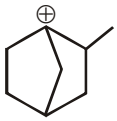
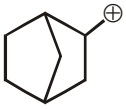
**11.** In each of the following pairs of ions which ion is more stable:

(a) (I) $C_6H_5-\overset{\oplus}{C}H_2$ and (II) $CH_2=CH-\overset{\oplus}{C}H_2$ (b) (I) $CH_3-\overset{\oplus}{C}H_2$ and (II) $CH_2=\overset{\oplus}{C}H$

(c) (I)  and (II) 

(d) (I) $CH_3-CH(CH_3)-\overset{\oplus}{C}(CH_3)-CH_3$ and (II) $CH_3-N(CH_3)-\overset{\oplus}{C}(CH_3)-CH_3$

**12.** Find out correct stability order in the following carbocations-

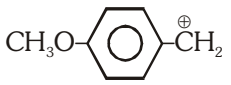
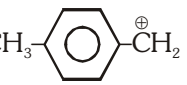
(I)  (II)  (III)  (IV)

(A) IV > I > III > II (B) IV > III > I > II (C) I > IV > III > II (D) I > III > IV > II

**13.** Which of the following carbonium ion is most stable ?

(A) $Ph_3C^+$ (B) $(CH_3)_3\ C^+$ (C) $(CH_3)_2\ CH^+$ (D) $CH_2=CH—CH_2^+$

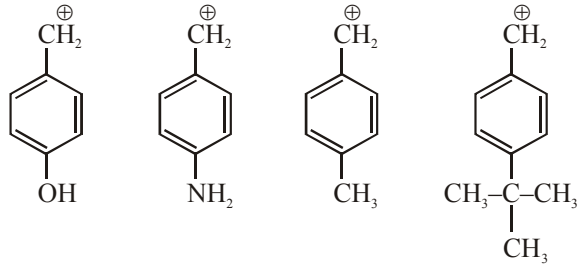
**14.** Consider the following carbocations

(a)  (b) (c)  (d) $CH_3—\overset{\oplus}{C}H_2$

The relative stabilities of these carbocations are such that :-

(A) d < b < c < a (B) b < d < c < a (C) d < b < a < c (D) b < d < a < c

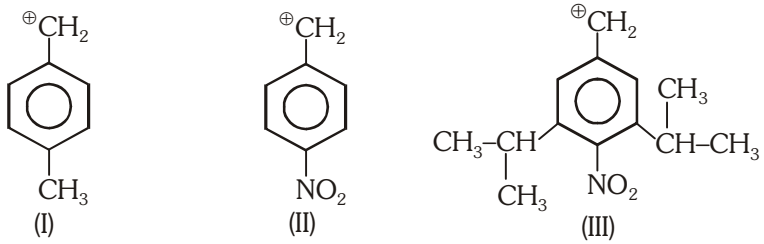
**15.**



Correct order of carbocation stability is :

(A) 2 > 1 > 4 > 3 (B) 1 > 2 > 4 > 3 (C) 3 > 4 > 2 > 1 (D) 2 > 1 > 3 > 4

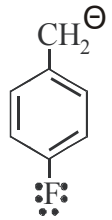
**16.** Arrange the following carbocation in the increasing order of stability :



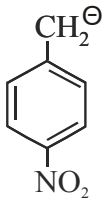
(A) I < II < III (B) II < III < I (C) III < II < I (D) III < I < II

**17.** Rank the following sets of intermediates in increasing order of their stability.

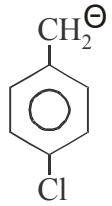
(i) (a)



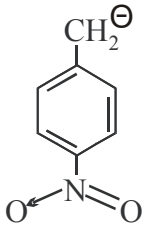
(b)



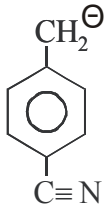
(ii) (a)



(b)



(c)



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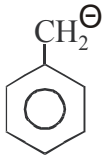

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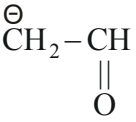
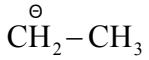


(b)



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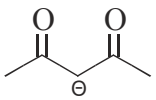

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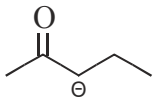

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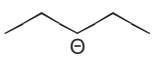
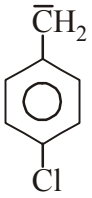
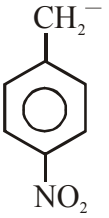
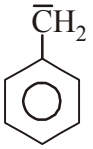
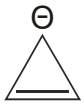
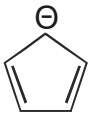
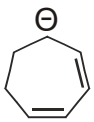
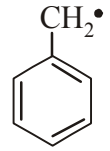
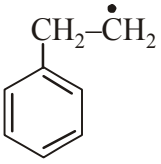
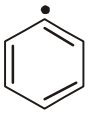
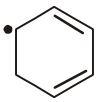
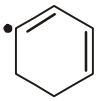
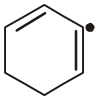
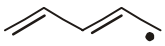
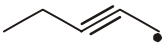


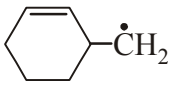
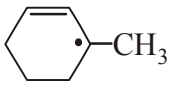
(v) (a)  (b)  (c) 

(vi) (a)  (b)  (c) 

(vii)(a)  (b)  (c) 

(viii) (a)  (b)  (c) 

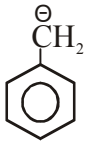
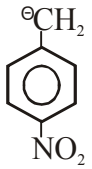
(ix) (a)  (b) 

(x) (a) $CH_2 = \dot{C}H$ (b) $CH_2 = CH - \dot{C}H_2$ (c)  (d) 

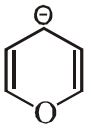
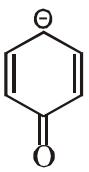
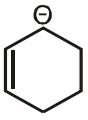
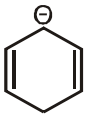
**18.** Most stable carbanion is :-

(A) $HC \equiv C^{\ominus}$ (B) $C_6H_5^{\ominus}$ (C) $(CH_3)_3C—CH_2^{\ominus}$ (D) $(CH_3)_2C=CH^{\ominus}$

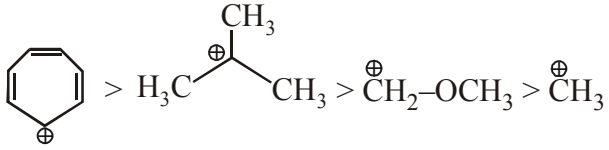
**19.** Most stable carbanion is :

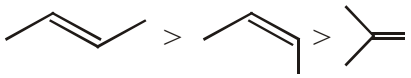
(A) $CH_3^{\ominus}$ (B) $CH_2 = CH - \overset{\ominus}{C}H_2$ (C)  (D) 

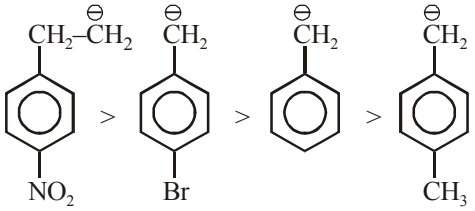
**20.** Identify the most stable anion.

(A)  (B)  (C)  (D) 

**21.** Correct order of stability :

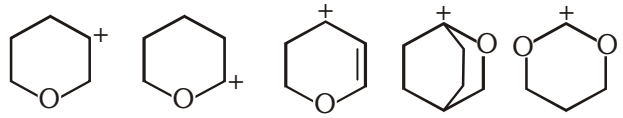
(A)  > $H_3C$ $CH_3$ > $CH_2$–$OCH_3$ > $CH_3$

(B) 

(C) 

(D) $CH_2$=CH–C($CH_3$)($CH_3$) > $CH_2$=CH–$CH_2$ > $CH_3$–$CH_2$ > $CH_2$=CH

**22.** Rank the following sets of intermediates in increasing order of their stability giving appropriate reasons for your choice.

(a) 

(b) $\bar{C}H_2$—C(=O)—$CH_3$ , $\bar{C}H_2$—C(=O)—H , $\bar{C}H_2$—C(=O)—$NH_2$ , $\bar{C}H_2$—C(=O)—$OCH_3$

**23.** Select the correct order of stability of carbon free radicals :

I. Ph–$\dot{C}H_2$

II. Ph–$\dot{C}$H–$CH_2$–$CH_3$

III. Ph–$\dot{C}$H–CH=$CH_2$

IV. Ph–$\dot{C}$($CH_3$)–CH=$CH_2$

(A) IV > III > I > II (B) IV > III > II > I (C) I > II > III > IV (D) I > III > II > IV

**24.** $CH_2$ = CH – CH = CH – $CH_3$ is more stable than $CH_3$ – CH = C = CH – $CH_3$ because

(I) (II)

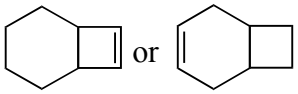
(A) there is resonance in I but not in II (B) there is tautomerism in I but not in II

(C) there is hyperconjugation in I but not in II (D) II has more cononical structures than I.

**25.** Choose the more stable alkene in each of the following pairs. Explain your reasoning.

(a) 1-Methylcyclohexene or 3-methylcyclohexene

(b) Isopropenylcyclopentane or allylcyclopentane

(c)  or 

**26.** Match each alkene with the appropriate heat of combustion:

Heats of combustion (kJ/mol) : 5293 ; 4658; 4650; 4638; 4632

(a) 1-Heptene

(b) 2,4-Dimethyl-1-pentene

(c) 2,4-Dimethyl-2-pentene

(d) 4,4-Dimethyl-2-pentene

(e) 2,4,4-Trimethyl-2-pentene

**27.** Stability of :

(I) $CH_3–CH=CH–CH_3$

(II) $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\underset{|}{\overset{|}{C}}}}=C-CH$

(III) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}}=CH_2$

(IV) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}}=CH-CH$

in the increasing order is :

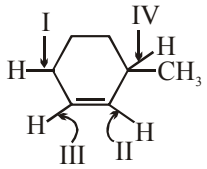
(A) I < III < IV < II

(B) I < II < III < IV

(C) I < IV < III < I

(D) II < III < IV < I

**28.** Which of the following C-H bonds participate in hyperconjugation ?



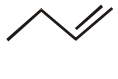

(A) I and II

(B) I and IV

(C) I and III

(D) III and IV

**29.** Rank the following alkenes in decreasing order of heat of combustion values :


(I)

(II)

(III)

(IV)

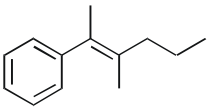
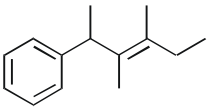
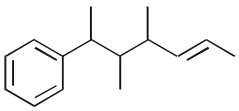
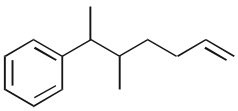
(A) II > III > IV > I

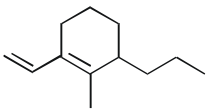
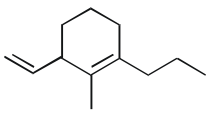
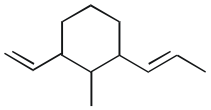
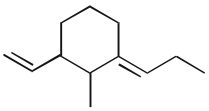
(B) II > IV > III > I

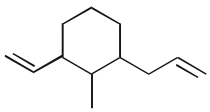
(C) I > III > IV > II

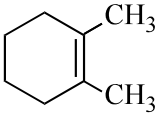
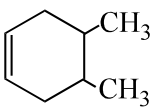
(D) I > IV > III > II

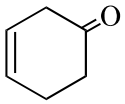
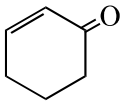
**30.** Write decreasing order of heat of hydrogenation :

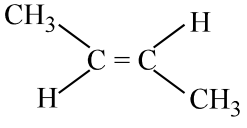
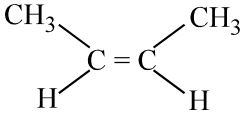
(i) (a)  (b)  (c)  (d) 

(ii) (a)  (b)  (c)  (d) 

(e) 

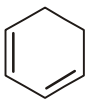
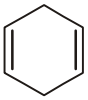
(iii) (a)  (b) 

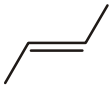
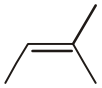
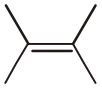
(iv) (a)  (b) 

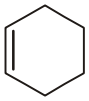
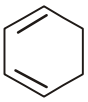
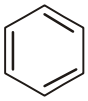
(v) (a)  (b) 

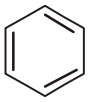
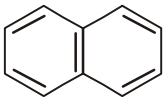
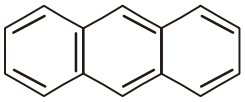
(vi) (a) $CH_2 = CH - CH(CH_3)_2$ (b) $CH_2 = C(CH_3)(CH_2{-}CH_3)$

**31.** Write increasing order of heat of hydrogenation :

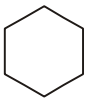
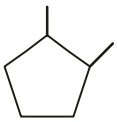
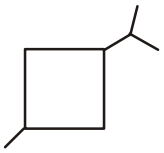
(i) (a)  (b) 

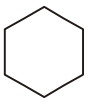
(ii) (a)  (b)  (c)  (d)  (e) 

(iii) (a)  (b)  (c) 

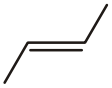
(iv) (a)  (b)  (c)  (HOH per benzene ring)

**32.** Give decreasing order of heat of combustion (HOC):

(i) (a)  (b)  (c) 

(ii) (a)  (b) (c) (d)

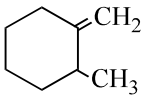
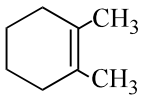
(iii) (a) (b)

(iv) (a) (b)  (c)

**33.** Among the following pairs identify the one which gives higher heat of hydrogenation :

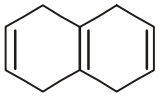
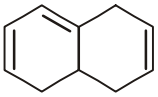
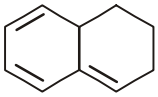
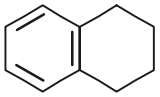
(a) and (b) and

(c) $CH_3 - CH = CH - CH_3$ and $CH_3 - CH_2 - CH = CH_2$

(d)   and  

**34.** Arrange the following compounds in order of :

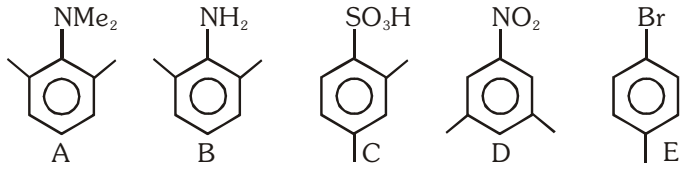
(I) Stability (II) Heat of hydrogenation

(a)  (b)  (c)  (d) 

**35.** If Heat of hydrogenation of 1-butene is 30 Kcal/mol then heat of hydrogenation of 1,3-butadiene is ?

(A) 30 (B) 60 (C) 57 (D) 25

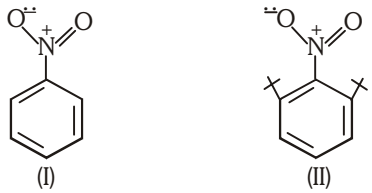
**36.**




Steric inhibition of resonance takes place :

(A) In A,B only (B) In A, B, C, E (C) C only (D) In A only

**37.** Consider the following two structures and choose the correct statements -



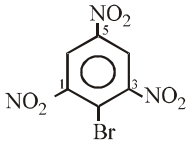

(A) carbon-nitrogen bond length structure I is greater than that in structure II

(B) carbon-nitrogen bond length in structure I is less than in structure II

(C) carbon-nitorogen bond length in both structure is same

(D) It can not be compared

**38.** Which of the following statements would be true about this compound :



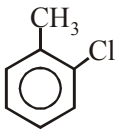

(A) All three C – N bonds are of same length.

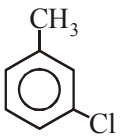
(B) Cl – N and C3 – N bonds are of same length but shorter than C5 – N bond.

(C) Cl – N and C3 – N bonds are of same length but longer than C5 – N bond.

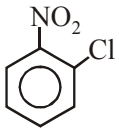
(D) Cl – N and C3 – N bonds are of different length but both are longer than C5 – N bond

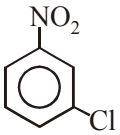
**39.** Arrange given compounds in decreasing order of dipole moment :

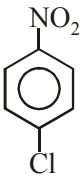
(i) (a) 

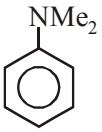

(b) 

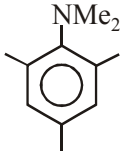

(c)

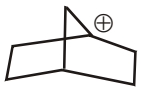

(ii) (a) 


(b) 


(c) 


(iii) (a) 


(b) 


**40.** Why a cation like  is not possible.

## EXERCISE # S-I

**1.** Cyclopentadienyl anion is much more stable than allyl anion because :

(A) Cyclic anion is more stable than acyclic anion

(B) Delocalised anion is more stable than localised anion

(C) Cyclopentadienyl anion is aromatic in nature

(D) None of these

**2.** Select correct statement regarding given compounds :

$CH_3OCH_3$ (I) $C_2H_5OH$ (II)

(A) Boiling point of II is higher than I

(B) Boiling point of II is lower than I

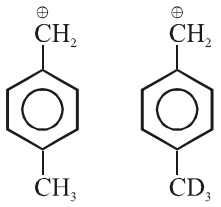
(C) Compound I forms intramolecular H-bonding

(D) Compound II forms intermolecular H-bonding

**3.** In the compund, $\overset{I}{CH_3}—\overset{II}{CH}=\overset{III}{CH}—\overset{IV}{C}\equiv N$, the most electronegative carbon is :

(A) I (B) II (C) III (D) IV

**4.**



(I)



(II)

Carbocation (I) is more stable than carbocation (II), because :

(A) $—CD_3$ has more + I effect than $—CH_3$ (B) $—CH_3$ has more + I effect than $—CD_3$

(C) $—CH_3$ has more + H effect than $—CD_3$ (D) $—CD_3$ has more + H effect than $—CH_3$

**5.** Select correct statement :

(A) Carbon-oxygen bonds are of equal length in acetate ion

(B) Resonating structures of acetate ion are equivalent

(C) Carbon-oxygen bonds are of unequal length in formate ion

(D) Resonating structures of formate ion are equivalent

**6.** Match the column I with column II.

| **Column-I** **(Group attached with benzene ring)** | **Column-II** **(Effect shown by the group)** |
|---|---|
| (A) —$NO_2$ | (P) – R effect |
| (B) —$O^-$ | (Q) + R effect |
| (C) —O—$CH_3$ | (R) + I effect |
| (D) —C ≡ N | (S) – I effect |

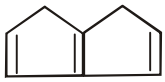
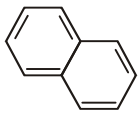
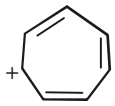
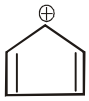
**7.**

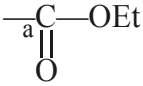
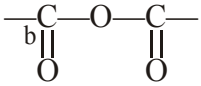
| **Column- I** **(Groups attached to phenyl ring)** | **Column- II** **(Effect shown)** |
|---|---|
| (A) —$\ddot{N}$ = O | (P) +M |
| (B) —$CH_3$ | (Q) –M |
| (C) —$\ddot{N}H - C(=O)CH_3$ | (R) +H |
| (D) $-C(=O)-OCH_3$ | (S) –I |

**8.** **Match the column :**

| **Column-I** | **Column-II** |
|---|---|
| (A) Group donate $e^-$ inductively but does not donate / withdraw by resonance | (P) –OH |
| (B) Group withdraw $e^-$ inductively but does not donate / withdraw by resonance | (Q) $-NO_2$ |
| (C) Group withdraw $e^-$ inductively & donate $e^-$ by resonance | (R) $-CH_2-CH_3$ |
| (D) Group withdraw $e^-$ inductively & withdraw $e^-$ by resonance | (S) $-\overset{+}{N}H_3$ |
| | (T) $-NH_2$ |

**9.** Match the column I with column II.

| **Column-I** | **Column-II** |
|---|---|
| (A)  | (P) Aromatic |
| (B)  | (Q) Non-aromatic |
| (C)  | (R) Anti-aromatic |
| (D)  | (S) Cyclic structure |

**10.** **Statement-I :**   bond length a < b

***Because***

**Statement-II :** More is the double bond character less is the bond legnth.

(A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.

(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.

(C) Statement-1 is true, statement-2 is false.

(D) Statement-1 is false, statement-2 is true.

**11.** **Statement-I :** $Me_3\overset{+}{C}$ is more stable than $Me_2\overset{+}{C}H$ and $Me_2\overset{+}{C}H$ is more stable than the $Me\overset{+}{C}H_2$.

***Because***

**Statement-II :** Greater the number of hyperconjugative structures, more is the stability of carbocation.

(A)Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.

(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.

(C) Statement-1 is true, statement-2 is false.

(D) Statement-1 is false, statement-2 is true.

**12.** **Statement-I :** The potential energy barrier for rotation about C = C bond in 2-butene is much higher than that in ethylene.

***Because***

**Statement-II :** Hyperconjugation effect decreases the double bond character.

(A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.

(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1

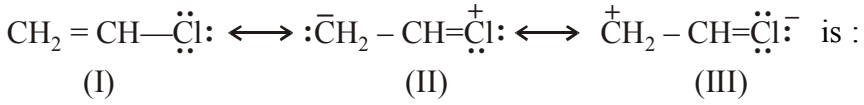
(C) Statement-1 is true, statement-2 is false

(D) Statement-1 is false, statement-2 is true.

**Paragraph for Question 13 to 15**

The intramolecular delocalisation of $\pi$ and non-bonding electrons without any change in the position of atoms is called resonance. Delocalisation may occur in conjugated system involving carbon atom and atom other than carbon. Delocalisation makes system stable. More is the number of resonating structures, more is the stability of the system. A resonating structure is less stable when a higher electronegative atom has positive charge and when identical charges are present on adjacent atoms.

**13.** The decreasing order of stability of the following resonating structures



(I) (II) (III)

(A) I > II > III (B) II > III > I (C) III > II > I (D) I > III > II

**14.** If A is Ph$\overset{+}{C}H_2$ and B is $CH_2$=CH—$\overset{+}{C}H_2$, the greater number of resonating structure is of -

(A) A (B) B (C) both A and B (D) None of these

**15.** Which of the following pairs represent resonance ?

(A) $CH_2 = CHOH$ ; $CH_3CHO$ (B) $\overset{\ominus}{C}H_2$–CHO ; $H_2C$=CH–$\overset{\ominus}{O}$

(C) $CH_3-\overset{O}{\overset{\|}{C}}-CH_3$ ; $CH_3-\overset{OH}{\overset{|}{C}}=CH_2$ (D) $CH_3-\overset{\overset{+}{O}H}{\overset{\|}{C}}-CH_3$ ; $CH_3-\overset{OH}{\overset{|}{\underset{H}{\underset{|}{C}}}}-CH_3$

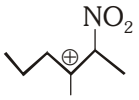
**Paragraph for Question 16 to 18**

Carbocation is a specie with positively charged carbon atom having six electrons in the valence shell after sharing. Carbocations are formed in the heterolysis of a bond and are planar species. Stability of carbocation is determined by inductive effect, hyperconjugation and resonance effect. Greater the number of contributing structures, more is the stability of a Carbocation. Electron releasing groups (+I effect) increases the stability of a carbocation whereas the electron withdrawing groups (–I effect) have an opposite effect.

**16.** Which of the following is most stable carbocation ?

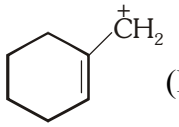
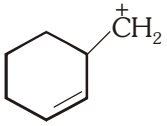
(A) $\overset{+}{C}H_3$ (B) $CH_3-\overset{+}{C}H-CH_3$ (C) $CH_3-\overset{+}{C}H_2$ (D) $CH_3-\overset{+}{\underset{CH_3}{\underset{|}{C}}}-CH_3$

**17.** The most stable carbocation among the following :

(A) (B) (C) (D) 

**18.** In which of the following cases, the carbocation (I) is less stable than the carbocation (II) ?

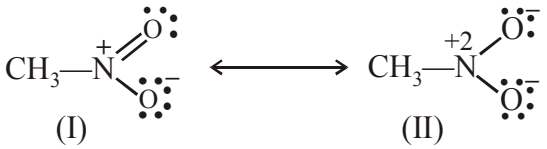
(A) $C_6H_5—\overset{+}{C}H_2$ (I), $CH_2= CH—\overset{+}{C}H_2$ (II)

(B)  (I),  (II)

(C) $CH_2=\overset{+}{C}H$ (I), $CH_3—\overset{+}{C}H_2$ (II)

(D) $H_3C—\overset{+}{C}H_2$ (I), $\underset{F}{\overset{|}{CH_2}}—\overset{\oplus}{C}H_2$ (II)

**19.** Examine the structures I and II for nitromethane and choose the statement correctly :



(I) (II)

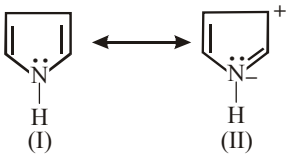
(A) Structure II is unlikely representation because electrons have shifted to oxygen

(B) Structure II is unlikely representation because nitrogen has sextet of electrons

(C) Structure II is acceptable and important

(D) None of these

**20.** Examine the following two structures for pyrrole and choose the correct statement given below



(I) (II)

(A) II is not an acceptable resonating structure because carbonium ions is less stable than nitride ion

(B) II is not an acceptable resonating structure because there is charge separation

(C) II is not an acceptable resonating structure because nitrogen has ten valance electrons

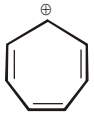
(D) II is an acceptable resonating structure

**21.** Delocalization of electrons increases molecular stability because :

(A) Potential energy of the molecule decreases (B) Electron-electron repulsion decreases

(C) Both (A) and (B) (D) Electron-electron repulsion increases

**22.** The most stable and the least stable carbocation among

(I)  (II) $CH_2=CH-\overset{+}{C}H_2$ (III) $C_6H_5-\overset{+}{C}H_2$ (IV) $CH_3-\overset{+}{C}H-CH_3$

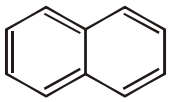
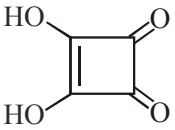
are respectively :

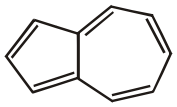
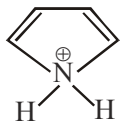
(A) II, I (B) III, IV (C) I, II (D) I, IV

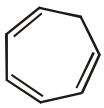
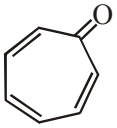
**23.** Most stable carbocation is formed by the heterolysis of :

(A) $(CH_3)_3CBr$ (B) $(C_6H_5)_3CBr$ (C) $(C_6H_5)_2CHBr$ (D) $C_6H_5CH_2Br$

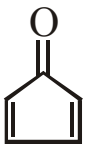
**24.** Total number of aromatic compounds

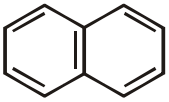
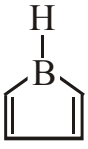
(a)  (b) 

(c)  (d) 


(e)  (f) 


**25.** Identify total number of compounds which are unstable at room temperature ?

(i) (ii) (iii) (iv) 


(v) (vi)  (vii) 

## EXERCISE # O-I

**1.** (D) **2.** (C) **3.** (B) **4.** (A,B,D) **5.** 4(b, d, f, g)

**6.** (a), (c), (d), (g), (j), (ℓ), (m) **7.** (A) **8.** (A) **9.** (A)

**10.** A,D **11.** (D) **12.** b, d, e **13.** b d e **14.** (d) **15.** c , f

**16.** a, b, c, d, f **17.** b, c, f **18.** **19.** a-I , b-II , c-II , d-II , e-I

**20.** a-I ,b-I, c-I, d-I, e-II, f-II **21.** a, e, f, g

**22.** (a) Resonance forms, (b) A , (c) C , (d) A & B, (e) B & C , (f) 0 , (g) B , (h) B

**23.** (a) II ; (b) II ; (c) II **24.** (A) **25.** a-II , b-II , c-II , d-II **26.** a & b

**27.** (i)-I , (ii)-II, (iii)-II, (iv)-I, (v)-I, (vi)-II , (vii)-I, (viii)-II, (ix)-II, (x)-II, (xi)-II ,(xii)-I, (xiii) -I , (xiv)-I, (xv)-I

**28.** a-II ,b-I, c-I, d-II, e-I **29.** (B) **30.** (D) **31.** (B) **32.** (C)

**33.** (C) **34.** (C) **35.** (D) **36.** (A,B,C) **37.** (B) **38.** (B)

**39.** (C) **40.** (D) **41.** (D) **42.** (A) **43.** (B,C,D) **44.** (B)

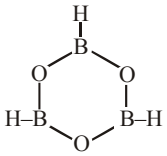
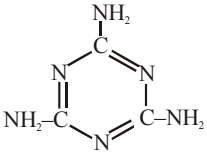
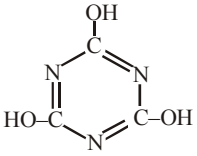
**45.** (A) **46.** (A,C,D) **47.** a-I ,b-I, c-II, d-I, e-I, f-I

**48.** a-II ,b-I, c-I, d-I, e-II, f-II **49.** (D) **50.** C>B>A **51.** (A)

## EXERCISE # O-II

**1.** (i) a, b ; (ii) a ,c ; (iii) b, c, d ; (iv) a, b, c, d, e, f

**2.** Aromatic→a, b, d, e, g ; Non-aromatic→c, f **3.** (C) **4.** (C) **5.** (B)

**6.** (A) **7.** (a)  (b)  (c) 

**8.** (D)

**9.** (i) c > b > a (ii) c > b > a (iii) b > c > a (iv) d > c > b > a (v) c > b > a
(vi) b > c > a (vii) c > b > a (viii) c>a>d>b (ix) b > c > a (x) c > a > b
(xi) c > a > b (xii) a > b > c > d (xiii) b>a>c>d (xiv) d > e > b > a > c
(xv) a > c > b (xvi) b > c > a

**10.** (C) **11.** (a) I ; (b) I ; (c) II ; (d) II ; **12.** (C) **13.** (A) **14.** (A)

**15.** (D) **16.** (B)

**17.** (i) a < b (ii) d < a < c < b (iii) b < a (iv) c < b < a (v) c < a < b (vi) a<c< b
(vii) c < b < a (viii) c < b < a (ix) b < a (x) a < c < b < d

**18.** (A) **19.** (D) **20.** (B) **21.** (D)

**22.** (a) IV<I<II < III < V (b) III < IV < I < II **23.** (B) **24.** (A)

**25.** (a) -I ; (b) - I ; (c) - II **26.** (a) 4658 ; (b) 4638 (c) 4632 ; (d) 4650 ; (e) 5293

**27.** (A) **28.** (B) **29.** (D)

**30.** (i) d > c > b > a ; (ii) e > c > d > b > a ; (iii) b > a (iv) a > b (v) b > a ; (vi) a > b

**31.** (i) a < b ; (ii) e < d < c < b < a ; (iii) a < c < b ; (iv) a > b > c

**32.** (i) c > b > a ; (ii) a > b > c > d ; (iii) a > b ; (iv) c > b > a

**33.** a - I ; b - I ; c - II, d - I **34.** Stability order : d>c>b> a ; HOH order : a > b > c > d

**35.** (C) **36.** (D) **37.** (B) **38.** (C)

**39.** (i) c > b > a (ii) a > b > c (iii) a > b

## EXERCISE # S-I

**1.** (C) **2.** (A,D) **3.** (D) **4.** (C) **5.** (A,B,D)

**6.** (A) $\rightarrow$ P, S ; (B) $\rightarrow$ Q,R ; (C) $\rightarrow$ Q,S ; (D) $\rightarrow$ P,S

**7.** (A) $\rightarrow$ P, Q, S ; (B) $\rightarrow$ R ; (C) $\rightarrow$ P, S ; (D) $\rightarrow$ Q, S

**8.** (A) $\rightarrow$ R ; (B) $\rightarrow$ S ; (C) $\rightarrow$ P, T ; (D) $\rightarrow$ Q

**9.** (A) $\rightarrow$ Q,S ; (B) $\rightarrow$ P,S ; (C) $\rightarrow$ P,S ; (D) $\rightarrow$ R,S

**10.** (D) **11.** (A) **12.** (D) **13.** (A) **14.** (A) **15.** (B)

**16.** (D) **17.** (C) **18.** (C) **19.** (B) **20.** (C) **21.** (C)

**22.** (D) **23.** (B) **24.** (4) **25.** (4)